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AN ANALYSIS OF ADVERTISING EFFECTIVENESS FOR U. S. NAVY RECRUITING

by

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This thesis estimates the effect of Navy television advertising on enlistment rates of high quality male recruits (Armed Forces Qualification Test (AFQT) score of 50 or higher and a high school diploma). Additionally, the effects of Navy radio, Navy journal, Navy direct mail, Joint television (Joint advertising is for all Armed Forces), Joint journal, and Joint direct mail advertising are explored. Enlistments are modeled as a function of several factors including advertising, recruiters, and economic. Regression analyses (Ordinary Least Squares and Two-Stage Least Squares) explore the relationship between male high quality contracts and various advertising and economic factors. Results indicate that Navy television advertising, Navy direct mail advertising, Navy radio advertising, Joint television advertising and Joint direct mail advertising have a significant impact on recruiting performance over time and across recruiting districts.

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AN ANALYSIS OF ADVERTISING EFFECTIVENESS FOR U. S. NAVY RECRUITING

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ABSTRACT

This thesis estimates the effect of Navy television advertising on enlistment rates of high quality male recruits (Armed Forces Qualification Test (AFQT) score of 50 or higher and a high school diploma). Additionally, the effects of Navy radio, Navy journal, Navy direct mail, Joint television (Joint advertising is for all Armed Forces), Joint journal, and Joint direct mail advertising are explored. Enlistments are modeled as a function of several factors including advertising, recruiters, and economic. Regression analyses (Ordinary Least Squares and Two-Stage Least Squares) explore the relationship between male high quality contracts and various advertising and economic factors. Results indicate that Navy television advertising, Navy direct mail advertising, Navy radio advertising, Joint television advertising and Joint direct mail advertising have a significant impact on recruiting performance over time and across recruiting districts.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The recruiting environment has been in a volatile state for the past several years. Achievement of recruiting goals has been more difficult due to various factors. Propensity to enlist has declined, the target population size is no longer experiencing growth, and budgets have been severely restricted. In such a rapidly changing environment, resources must be used effectively. This thesis shows how advertising impacts recruiting performance.

Advertising is a key policy tool used by the services in support of the all-volunteer force. Despite the importance of advertising in the achievement of recruiting goals, there is no general consensus concerning the amount and type of advertising necessary.

This thesis estimates the effect of Navy television advertising on enlistment rates of high quality male recruits (Armed Forces Qualification Test (AFQT) score of 50 or higher and a high school diploma). Additionally, the effects of Navy radio, Navy journal, Navy direct mail, Joint television (Joint advertising is for all Armed Forces), Joint journal, and Joint direct mail advertising are explored. Regression analyses (Ordinary Least Squares and Two-Stage Least Squares) explore the relationship between male high quality contracts and various advertising and economic factors.

Results from the analyses indicate that Joint direct mail advertising, Joint television advertising, Navy radio advertising, Navy direct mail advertising, and Navy television advertising are statistically significant in influencing male high quality recruit new contracts.

I. INTRODUCTION

This thesis estimates the effect of Navy television advertising on enlistment rates of high quality male recruits (Armed Forces Qualification Test (AFQT) score of 50 or higher and a high school diploma). Additionally, the effects of Navy radio, Navy journal, Navy direct mail, Joint television (Joint advertising is for all Armed Forces), Joint journal, and Joint direct mail advertising are explored. Regression analyses (Ordinary Least Squares and Two-Stage Least Squares) explore the relationship between male high quality contracts and various advertising and economic factors.

Since the implementation of the All-Volunteer Force (AVF) in 1973, military recruiting has experienced many changes. Initially, recruiting efforts were largely successful. After 1978, problems began to surface and shortfalls in meeting recruiting goals averaged about ten percent for several years [Goldberg, 1982]. The 1980s presented a new challenge due to the decline in the youth population. By the late 1980s, all the services were having difficulties recruiting enough male high school graduates [Lewin, 1996].

Due to the budget reductions facing Commander, Navy Recruiting Command (CNRC), the 1990s required changes in the status quo. In response, the Navy eliminated national television advertising from January 1991 to January 1993. Magazine, newspaper, radio and direct mail advertising continued to be funded. By getting out of the television advertising market, the Navy significantly reduced advertising costs, but this approach

proved to be unsuccessful. During this period, CNRC had greater difficulty achieving the recruiting mission. [Orvis, et al., 1996]

Analysis of advertising effectiveness can provide CNRC with a tool to defend the large budget allotments required for television advertising. Through the analysis of data from FY1991 - FY1995, this thesis estimates the relationship between male high quality new recruit contracts and various forms of advertising (Navy television advertising, Navy radio advertising, Navy journal advertising, Navy direct mail advertising, Joint television advertising, Joint journal advertising, and Joint direct mail advertising). Estimates of the elasticities of advertising resources allow CNRC to adjust overall advertising strategy as the recruiting climate changes.

Findings from the analysis can provide input for CNRC's AdPRO optimization program. The AdPRO program estimates the required resources to achieve a given mission in a specified environment. It can also be used to estimate the impact of changing resources. AdPRO breaks the budget into separate media types, namely: television, radio, journal and direct mail. This breakdown helps CNRC adjust its advertising program and the mix between various advertising media as budget levels change. [McCloy et al., 1992]

Chapter II gives some necessary background, a literature review, and a discussion of the methodology used in the regression analysis. Chapter III contains the data analysis and results obtained. Chapter IV has conclusions concerning the analysis and recommendations for future studies. This thesis concludes with three appendices containing regression results.

II. METHODOLOGY

A. GENERAL CONSIDERATIONS

With the AVF in place, each service competes with the civilian sector and the other services to recruit high-quality candidates. At the individual level, the decision to enlist is a function of the benefits and costs of joining. Perceptions of the benefits are influenced through the use of various advertising media and through recruiter prospecting.

The recruiting process can be broken down into a demand and a supply function. This thesis concentrates on analysis of the determinants of supply, cross-sectionally and over time. Enlistments (E) are modeled as a function of several factors including recruiters (R), advertising (A), and exogenous factors (X) such as military to civilian pay ratio, unemployment rate and size of the male high quality population. The advertising component can be broken down by type (e.g., TV, radio, journal, newspaper, and direct mail) to provide information on various advertising media.

Occupational choice theory provides a starting point for considering enlistment supply. Human capital development is an important factor in the enlistment decision. Individuals are more willing to join the military if the skills learned can be easily transferable to other occupations. Availability of educational benefits is another important factor which may influence the enlistment decision. [Warner and Asch, 1995]

In addition to skill development and thus opportunities, environmental influences also play a significant role in the decision to enlist. Advice of family and friends and societal attitudes toward military service impact the enlistment decision. The final source

of influence during the enlistment process is the recruiting establishment itself. Warner and Asch [1995] state:

> The military services make a wide range of decisions regarding how to manage recruiting resources, including selecting recruiters, training them, and allocating them to recruiting stations throughout the country and selecting the level and allocation of advertising resources across media type. The services manage recruiters by assigning them quotas for the quantity of enlistments they make and for various enlistment categories (e.g., male versus female). They also generally use incentive plans that reward recruiters for various aspects of their productivity, such as certificates, badges, and improved promotion chances.

The recruiting process begins with an individual who is interested in joining the Navy. This person's interest could have been generated in many ways. The prospect could have been exposed to Navy advertising or could have been the recipient of a local recruiting campaign. The prospect either becomes a local lead (e.g., by visiting a recruiting station) or a national lead (e.g., by calling the Navy toll-free number or by returning a magazine insert). The prospect is then interviewed by a recruiter to determine qualification. Qualified prospects receive a sales pitch from the recruiter. Recruiting success results if the prospect signs either a Delayed Entry Program (DEP) contract for accession within 12 months or a Direct Shipment (DSHIP) contract for immediate accession.

Advertising and personal selling can be influential at various points of the recruiting process. For example, recruiting visits are made to high schools to generate interest among seniors. National advertising can generate calls to a toll-free number or could cause a

prospect to visit a local recruiting station. Figure 1 provides a schematic model of the recruiting process as outlined by Hanssens and Levien [1983].

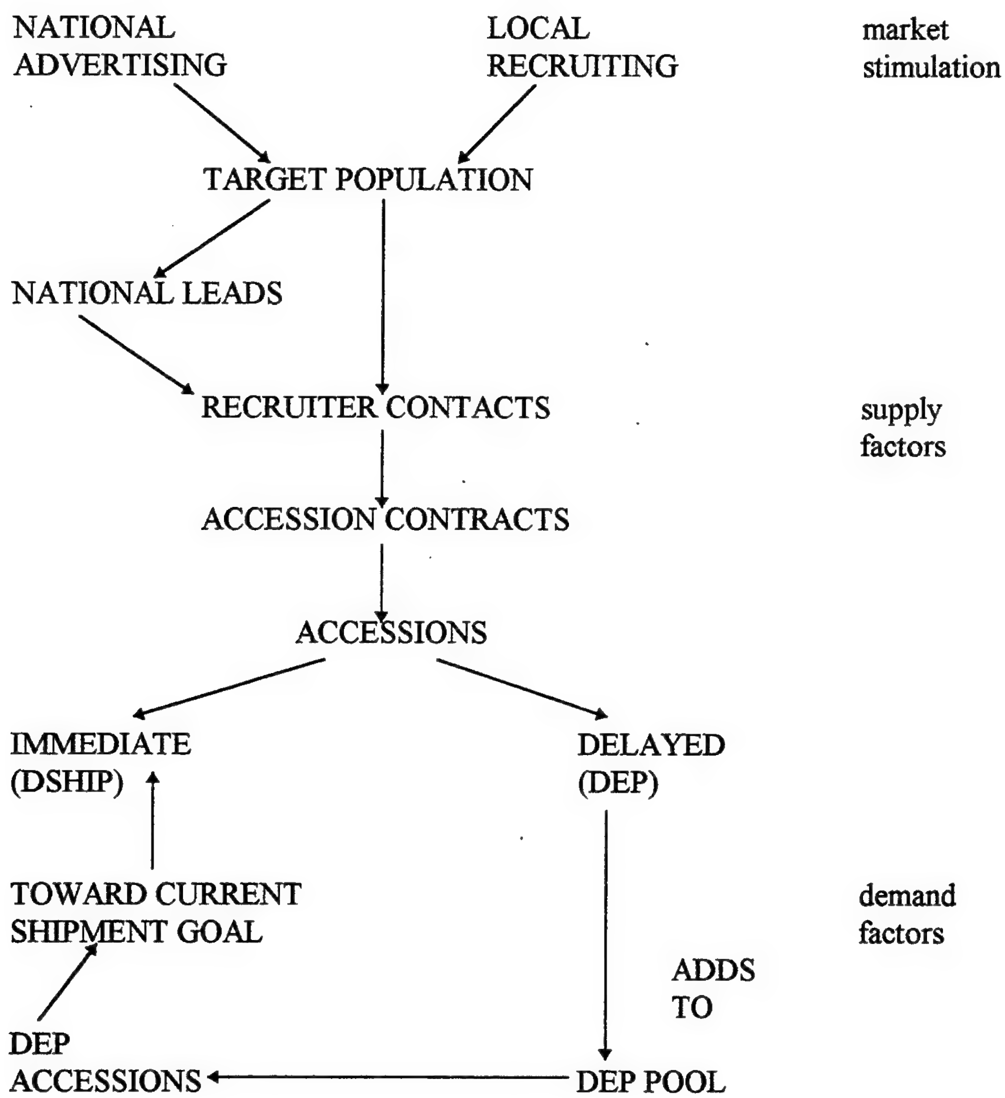


Figure 1. A Schematic Model of Recruit Supply and Demand.

The majority of the advertising efforts (television, newspaper, direct mail, magazines, and radio) are at the national level. However, each district has a small budget for local newspaper, radio, and direct mail advertising.

The different media forms address different audiences. Network television, while very expensive, reaches a broad base. Cable television provides a means to target a more specific audience. A major drawback of television advertising is that it must be programmed well in advance. Magazine advertising must also be prepared well in advance, but provides an opportunity for detailed copy which can be reviewed by both the influencers (teachers, parents, counselors) and the prospect at their leisure. Radio advertising provides a quick means to reach an audience frequently. Direct mail provides the most effective means for reaching a very specific market.

Regardless of the media, Navy advertising falls into two distinct categories – awareness advertising and lead generation. The Navy uses awareness advertising to keep a positive public image. Lead generation advertising, targeted at the 17 to 21 year old male market, generates leads for recruiters.

Lead generation supports both the quantitative and the qualitative goals of the Navy's contract mission. The number of new contracts that must be written to achieve Navy manpower needs in a given year is called the new contract objective. On an annual basis, the Navy bases the new contract objective on the following: (1) the number of individuals currently in the DEP; (2) the number of accessions needed for the current year (most come from the DEP, but some come from DSHIP); and, (3) the number of individuals desired to be in the DEP at year's end. In order to qualitatively assess potential

enlistees, the Armed Forces use a categorical system (See Figure 2). Individuals are categorized using the Armed Forces Qualification Test (AFQT) score and high school diploma status. Quality targets for new recruits are 95 percent with high school diplomas and 65 percent in mental category I-IIIa. Applicants in Cell D are considered least desirable for enlistment. Applicants in AFQT categories IVc and V are ineligible for enlistment.

<table>
<tr><th>AFQT Category:</th><th>Score</th><th>High School <u>Graduate</u></th><th>Non High School <u>Graduate</u></th></tr>
<tr><td>I</td><td>93-99</td><td rowspan="3">A</td><td rowspan="3">B</td></tr>
<tr><td>II</td><td>68-92</td></tr>
<tr><td>IIIa</td><td>50-91</td></tr>
<tr><td>IIIb</td><td>34-49</td><td>Cu</td><td rowspan="3">D</td></tr>
<tr><td>IVa</td><td>21-33</td><td>Cl</td></tr>
<tr><td>IVb</td><td>16-20</td><td>D</td></tr>
<tr><td>IVc</td><td>10-15</td><td rowspan="2" colspan="2"></td></tr>
<tr><td>V</td><td>0-9</td></tr>
</table>

Figure 2. Armed Forces Recruit Categorization Matrix.

B. CURRENT SITUATION

1. Recruit Demand

The Lewin Group and SAG Corporation [1996] provide useful insight on current recruiting issues:

> Now that the drawdown in active forces following the end of the Cold War nears completion, the demand for recruits will begin to increase again toward a steady state level consistent with a lower, but roughly constant, force size. The demand for recruits is approximately equal to the losses from the inventory, plus the change in desired strength. In the late 1980's until recent, the change in desired strength has been negative, driving down the demand for accessions. Now, this change will approach zero, so that recruit demand will be determined by the losses from the existing strength. This demand will be lower than that of the early 1980's because force sizes are lower. However, it will be higher than during the period when desired strength was declining from year to year.

Figure 3 shows the recent fluctuations in demand for new recruits, as described above [Bohn, 1997].

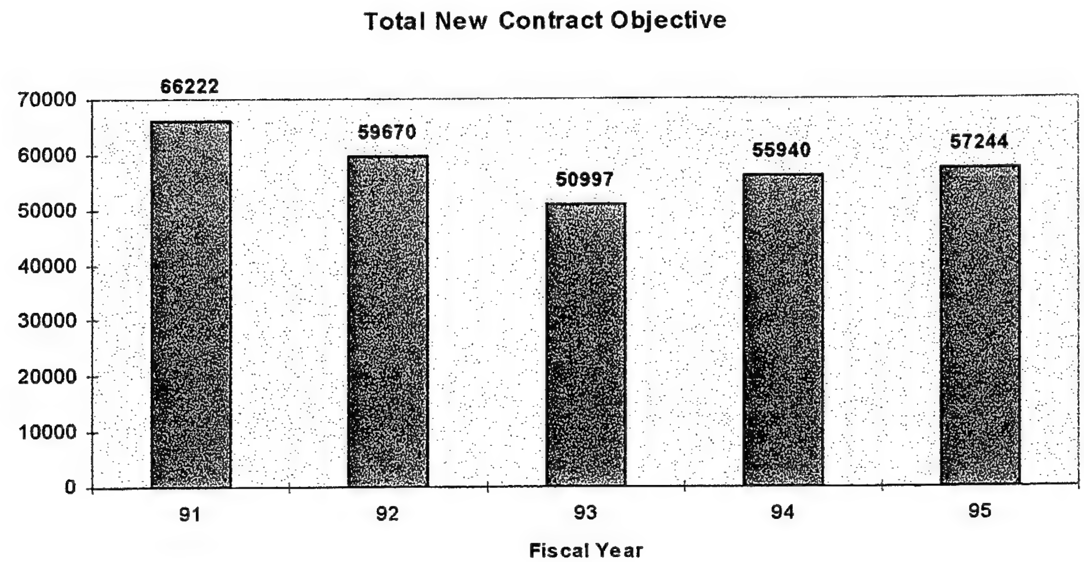


Figure 3. Total New Contract Objective for Fiscal Years 1991 - 1995.

2. Resource Allocations

Resource allocations in the form of recruiters and advertising expenditures varied during the period under study. Substantial cuts were made in many areas as a part of the post-Cold War military drawdown. Table 1 and Figure 4 show significant variation in total annual Navy advertising expenditures for FY 1980 - 1996 [Bohn, 1997]. Expenditures are expressed in constant 1995 dollars. Figure 5 depicts the variation in average New Contract Objective (NCO) per month and average number of recruiters per month for FY 1991 - 1995 [Bohn, 1997]. The gap between average NCO per month and average number of recruiters per month was narrowing until 1993. Average NCO per month began rising in 1994, while average number of recruiters per month was still declining.

FY	Constant Dollars
1980	**32.2**
1981	**29.0**
1982	**23.9**
1983	**22.3**
1984	**18.4**
1985	**27.4**
1986	**42.0**
1987	**19.6**
1988	**24.6**
1989	**23.6**
1990	**29.5**
1991	**18.5**
1992	**15.1**
1993	**16.3**
1994	**30.2**
1995	**36.0**
1996	**36.0**

Table 1. Annual Advertising Expenditures in Constant 1995 Dollars (in millions).

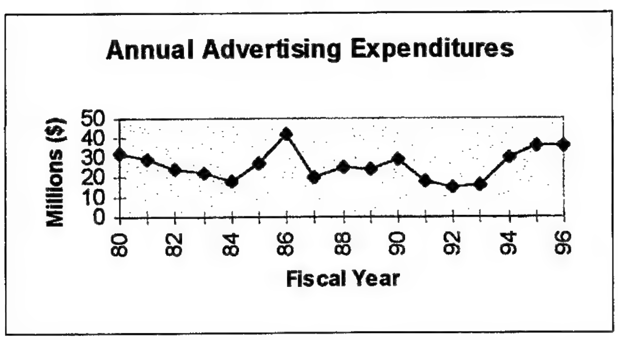


Figure 4. Annual Advertising Expenditures in Constant 1995 Dollars.

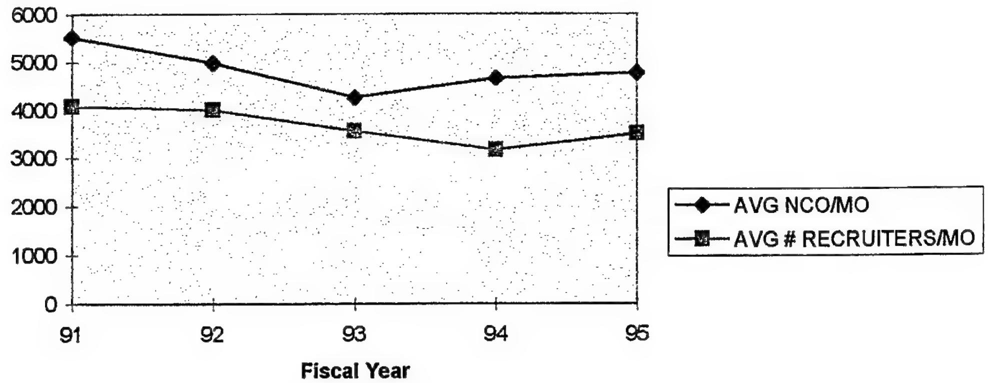


Figure 5. Average New Contract Objective per month and Average Number of Recruiters per month.

C. LITERATURE REVIEW

1. Basic Findings

Currently, there is no general consensus on the effectiveness of advertising for recruiting. Many studies have been conducted in an attempt to quantify the effect of advertising on sales of commercial products. A smaller number of studies have been conducted on the effectiveness of advertising on military recruiting. While most studies find the effect of advertising to be statistically significant, there is no agreement on how much advertising can be expected to contribute to recruiting. The issue of quantifying the effects of advertising on recruiting is approached through the use of inferential studies. To conduct an inferential study, analysts must consider all factors which might affect the enlistment decision. Factors which are typically considered include the following: advertising, recruiter salaries, enlistment bonuses, contract mission, unemployment, and military to civilian pay ratio.

Experimental and data-based studies are both common. Experimental studies generally examine the relationship between advertising costs and enlistment contracts produced for statistically comparable areas. Data-based studies use historical time series data to evaluate how various levels of recruiting resources contribute to recruiting goal achievement. Recruiting goals can be expressed in many different ways. Examples of goals set for recruiters include the number of accessions, quality of accessions, and percentage of various minority groups. Results from data based studies are commonly expressed in terms of elasticities for the recruiting resources explored.

2. Enlistment Supply Literature

A rational enlistment decision can be described using occupational choice theory. Individuals considering military service must compare the pay and benefits available in the military sector with those available in the civilian sector. Traditionally, military service has been considered to also provide many non-pecuniary advantages over civilian employment. The opportunity for travel, service to one's country, and stable employment are examples of non-pecuniary benefits available from military service. In order to make the decision to join the military, the rational individual must determine that the utility of joining the military is greater than the utility of remaining in the civilian sector. The utility of joining the military can be represented as $U^M = W^M + \tau^M$, where W^M represents military wages and τ^M represents non-pecuniary benefits of military service. Similarly, the utility of remaining in the civilian sector can be represented as $U^C = W^C + \tau^C$, where W^C represents civilian wages and τ^C represents non-pecuniary benefits of civilian employment. Simply stated, rational

individuals join only if the pay differential (W^M - W^C) exceeds their net preference for civilian life, $\tau = \tau^C - \tau^M$. [Warner and Asch, 1995]

Several tools are available to the services which can be useful in influencing enlistments or enlistment quality. Conditions in the civilian labor market can necessitate changes in the number of recruiters, in the level of advertising expenditures, and in educational benefits offered. These factors can be manipulated to compensate for changes in demand and changes in the economic factors affecting enlistments.

3. Advertising Effectiveness Literature

a) Experimental Studies

The Morell Study which examines advertising return on investment was funded in the 1950s by McGraw-Hill. McGraw-Hill wanted to show that advertising supplements personal selling. The study examines cost and sales records for over 600 firms. Findings of the study indicate that a sales staff supported by advertising dollars produces more sales per dollar of sales expense (advertising expenditures plus sales salaries and expenses). [Wittenburg, 1996]

During the 1970s and the 1980s, the Wharton School of Business conducted two market experiments on advertising for the Department of Defense (DOD) [Carroll, 1987]. The first experiment finds that advertising at the national level is insignificant in realizing new enlistments. The Office of the Secretary of Defense (OSD) chartered a second study, titled "DOD Advertising Mix Test", to determine the effectiveness of joint-service advertising versus individual service advertising. Data used in

the study includes all advertising by the individual services and the Joint Recruiting Advertising Program (JRAP). The study finds joint-service advertising to be more cost effective than individual service advertising. RAND later criticized the study for poor documentation and questionable design [Dertouzos, 1989]. Despite the questions surrounding this study, it considers many of the factors essential to measuring advertising return on investment.

b) Data-Based Studies

Most of the early literature on military recruiting concentrates on the influence of civilian unemployment levels and the military to civilian pay ratio. During the 1980s the effectiveness of advertising on recruiting began to be more aggressively explored.

Hanssens and Levein [1983] completed an econometric study of recruitment marketing for the Navy. This study includes an analysis of advertising and personal selling effects. Additionally, it examined advertising lag and wear-out. Advertising lag represents the possibility that individuals exposed to the advertising message may not respond in the same time period, but may respond later. The concept of wear-out expresses the idea that the response of sales to increased advertising pressure is immediate, but levels off even if the high advertising level is maintained. If the assumption is made that certain individuals in the target market are more likely to join the military than others, then wear-out in the recruiting environment can be expected for two reasons: (1) as individuals enlist in response to the campaign, the size of the target market decreases, and (2) remaining individuals are less likely to join the military. The study finds wear-out to be significant for

national television advertising and national print advertising. The study finds a one month lag for national advertising on leads, and a two month lag for direct mail. Additionally, the analysis shows up to a one month lag for leads on contracts.

Morey and McCann [1983] conduct a two-stage approach linking advertising to leads and then leads to contracts. They find local classified advertising to be the most cost effective among national television, all radio, all direct mail, and local classified advertising during 1976-1979. This study also addresses recruiter strength through the use of a military supply model.

Daula and Smith [1986] conduct a study using an enlistment supply model for Army A-cell contracts. They include measures for local and national advertising effectiveness. Their results estimate local advertising as having an elasticity of 0.02 and national advertising as having an elasticity of 0.08.

Dertouzos and Polich [1989] estimate the effect of different advertising media types on male Army A-cell contracts. Their study uses data at both the national and local level. Results indicate that television, national radio, magazines, and daily newspapers had positive significant effects on enlistments. Dertouzos and Polich also estimate a depreciation rate for advertising. They find that the delayed effect of advertising in the month following the initial exposure was 58 percent of the initial effect. In terms of cost per high quality enlistment, they find national and local advertising programs to compare favorably with other recruiting resources.

Warner [1990] conducts a study on military recruiting programs. He finds that the military to civilian pay ratio and the unemployment rate are important determinants

of high-quality enlistments. Additionally, number of recruiters, recruiting goals, educational benefits, and advertising are also important factors. For the Army, Warner finds that the most cost-effective way to control high-quality enlistments was through the use of advertising and recruiters. His model estimates the elasticity of national advertising (television, radio, and journals) as 0.05. Warner experiments with different depreciation rates for advertising but finds little evidence to support a specific value. Warner concludes that the high depreciation rate found by Dertouzos was not unreasonable.

The main area of focus for many of the studies in recruiting has not been advertising. Due to a wide variety of focuses, many different econometric techniques and models have been used. Additionally, advertising has very rarely been disaggregated by type of expenditure. For these reasons, it has been difficult to reach a consensus on the effect of advertising on enlistments.

D. APPROACH

The number of impressions advertising generates, which measures the number of times the 18-24 year-old market is exposed to the advertising message, can be employed in an enlistment supply model in a number of ways. The most common approaches used in the literature are as a "stock" variable or a "flow" variable. The flow variable assumes that advertising is effective only in the period in which the advertising takes place, while the stock variable assumes that advertising in the current period also affects enlistments in future periods. This thesis uses the latter approach. The following equation describes the method used to figure the stock of monthly advertising impressions; δ is the depreciation

rate, I_t is the number of impressions in period t, and TI_t is the total impressions in a given period. The total stock of advertising in period t is:

$$TI_t = \sum_{i=1}^{12} (1-\delta)^i * I_{t-i} .$$

The accumulation of advertising as a stock variable goes back twelve months. The total impressions for January 1995, is the sum of the impressions generated from January 1994 through December 1994, and does not include the impressions during January 1995. Impressions for the current month are not included in the "stock" of advertising capital until the month succeeding the advertisement. This thesis uses the same rate of depreciation for all advertising variables in each model.

This thesis uses both ordinary least squares (OLS) and two-stage least squares (2SLS) within the Statistical Package for The Social Sciences (SPSS) software [Nie et al., 1975].

Using OLS, the model being fit is as follows:

$$\mathbf{y} = \mathbf{X}\beta + \varepsilon,$$

where y is an $n \times 1$ vector of male A-cell contracts, $\mathbf{X}$ is an $n \times K$ matrix of constants, ε is an $n \times 1$ vector of residuals, and β is a $K \times 1$ vector of unknown coefficients. The

identities of the variables defining the columns of **X** are discussed in the Data Description section of the Data Analysis chapter.

The standard assumptions underlying the OLS model are as follows:

1. The columns of **X** are linearly independent.

   $\mathbf{X}$ is $n \times K$ with rank K

2. The expected value of the residual is zero at every observation.

   $E[\varepsilon \mid X] = 0$

3. The variance of the residual is constant and the residuals are uncorrelated across observations.

   $E[\varepsilon\varepsilon' \mid X] = \sigma^2 I$, where I is the identity matrix

4. The residuals are normally distributed.

Satisfying 1-3 ensures that the components of the OLS estimate for β are all unbiased, and have the smallest possible variances among all possible estimators. Assumption 4 is necessary for standard inferential methods (tests of hypotheses, confidence intervals).

Using Two Stage Least Squares (2SLS), the final model has the same structure as that specified above. However, determination of the final coefficients is different from the method for OLS. Using instrumental variables that do not uncorrelate with the error terms, 2SLS regression computes estimated values for some of the explanatory variables. This is considered the first stage. During the second stage, using the estimates from the first stage, a linear regression model of the dependent variable is obtained [Greene, 1997].

2SLS requires that some variables be classified as instrumental. Determination of instrumental variables is independent of the process described by the equation system, i.e., "from outside" the system. In statistical terms, the assumption that instrumental variables are stochastically independent of the disturbances of the system leads to consistent estimates of the parameters. Under OLS, estimates of the parameters may not be consistent if there is correlation between the residuals and the regressors.

SPSS handles 2SLS by classifying variables into the following three categories; dependent, explanatory (predictor), and instrumental. All endogenous variables must be classified as explanatory. Any exogenous variables included in the explanatory variables list are usually also included in the instrumental list. The instrumental list must contain at least as many variables as the explanatory list. If all explanatory variables are in the instrumental list, the results from 2SLS are the same results as those obtained using OLS.

The method of instrumental variables is a general extension of the classical regression model:

> Suppose that in the classical model $y_i = x'_i\beta + \varepsilon_i$, the K variables x_i may be correlated with ε_i. Suppose, as well, that there exists a set of L variables z_i, where L is at least as large as K, such that z_i is correlated with x_i but not with ε_i. We cannot estimate β consistently by using the familiar least squares estimator. But, we can construct a consistent estimator β by using the assumed relationships among z_i, x_i, and ε_i. [Greene, 1997]

E. DATA

1. Type

CNRC provided the data for this thesis, covering the period FY1991 - FY1995. This includes monthly data provided by Navy Recruiting District (NRD) for all DEP and DSHIP male A-cell contracts, as well as for all explanatory variables with the exception of the following; unemployment rate, size of the male AFQT test category I-IIIa population, and civilian to military pay ratio. Quarterly data are provided for these three variables. Dummy variables account for the effects of seasonality, Desert Storm, and NRD. Eleven binary variables indicate months of the year, a single binary variable indicates Desert Storm (October 1990 - February 1991), and 30 binary variables indicate NRD. The investigation of both linear and quadratic time trend effects is undertaken, additionally.

2. Sources

P.E.P. Research provides impression figures for 18-24 year-olds for all advertising types. CNRC provides Navy advertising source data. Joint Recruiting Advertising Program (JRAP) provides Joint advertising source data. Unemployment rate figures are seasonally adjusted unemployment rates from the Bureau of Labor Statistics. To obtain the size of the male test category I-IIIa population, CNRC uses population counts at the zip code level and then applies factors developed at the Naval Postgraduate School by George Thomas [Bohn, 1997], to break down the population by test category. These figures are then aggregated to the NRD level. Military to civilian pay ratio figures compare military E-1 pay to youth earnings from the Current Population Survey.

3. Concerns

Some OLS regression assumptions may not be satisfied for the data under analysis. Issues to look for include omitted variables, non-constant variance of errors (heteroscedasticity), non-linear relationships, non-normal errors, and influential cases.

a) Heteroscedasticity

Since heteroscedasticity is common with time-series data, it is of particular concern with this set of data. It is importanct to avoid heteroscedasticity because if the variance of the errors changes with the level of **X**, hypothesis tests and confidence intervals may be unreliable. This thesis compensates for heteroscedasticiy through the use of time variables.

b) Multicollinearity

The independent variables may exhibit notable multicollinearity (regressors that are highly correlated). Multicollinearity is of concern because it can cause small changes in the data to produce wide variations in the parameter estimates. Additionally, coefficients may have high standard errors and low significance levels despite the fact that they are jointly highly significant and the R^2 for the regression is high. [Greene, 1997]

c) Censored Data

Censoring of the dependent variable is common in microeconomic data. The dependent variable, male A-cell contracts, in this analysis is censored. The following example concerns censored random variables.

> We are interested in the number of tickets demanded for events at a certain arena. Our only measure is the number actually sold. Whenever an event sells out, however, we know that the actual number demanded is larger than the number sold. The number of tickets demanded is censored when it is transformed to obtain the number sold. [Greene, 1997]

Male A-cell contracts can not exceed the new contract objective. If supply of male A-cell contracts exceeds the new contract objective, the dependent variable is censored at the new contract objective. Any additional supply is not reflected properly. The use of male A-cell new contracts as the dependent variable instead of all new contracts partially compensates for this issue.

d) Additional Concerns

Omission of important variables in the regression model can cause the relationship between the dependent variable and the independent variables to be either understated or overstated.

In the event of non-normal errors, customary t and F procedures may not be valid since they rely on the assumption of normally distributed residuals. Non-normal errors may increase sample to sample variation of estimates.

Finally, it is important to consider influential cases, since a single outlier can unduly affect the estimate of β. This can substantially influence all results.

III. DATA ANALYSIS

A. DATA DESCRIPTION

Dependent variable (**y**):

MA	-net male A-Cell contracts (gross contracts minus attrition from the delayed entry program, monthly data by NRD)

Independent variables (columns of **X**):

TTREND	-Linear time trend, months numbered 1, 2, …, 60
TTREND2	-Square of the above variable
DSTORM	-Desert Storm (binary variable set equal to one if the observation took place during Desert Storm (October 1990 - February 1991)
NRD	-Navy Recruiting District followed by a three digit number, 30 binary variables used to account for the regional effects of 31 districts
FEB-DEC	-Months of the year, used to account for seasonality
NCO	-Final new contract objective (monthly data by NRD)
RECR	-number of production recruiters (monthly data by NRD)
MUMG	-number of males in the target population (17-21 year old) in the upper mental group (quarterly data by NRD)
UNEMP	-percent of the workforce which is unemployed (quarterly data by NRD)
MCPR	-military to civilian pay ratio (quarterly data by NRD)

NJIS10	-impressions from Navy journal advertising modeled as a stock variable with a ten percent depreciation rate (this variable and the ones that follow appear several times followed be a different number to represent the various depreciation rates examined, monthly data by NRD)
NMIS10	-impressions from Navy direct mail advertising modeled as a stock variable with a ten percent depreciation rate (monthly data by NRD)
NRIS10	-impressions from Navy radio advertising modeled as a stock variable with a ten percent depreciation rate (monthly data by NRD)
NTIS10	-impressions from Navy television advertising modeled as a stock variable with a ten percent depreciation rate (monthly data by NRD)
JMIS10	-impressions from joint direct mail advertising modeled as a stock variable with a ten percent depreciation rate (monthly data by NRD)
JTIS10	-impressions from joint television advertising modeled as a stock variable with a ten percent depreciation rate (monthly data by NRD)
JJIS10	-impressions from joint journal advertising modeled as a stock variable with a ten percent depreciation rate (monthly data by NRD)

B. REGRESSION ANALYSIS

1. Method

The first step in the data analysis is a review of the data to eliminate any significant outliers. One obvious outlier is male A-cell value of 532, which is significantly larger than all other male A-cell values. Since this observation is from NRD 532, it appears to be a data entry error. Regression analyses are then accomplished on the entire data set

consisting of 1,859 cases (60 months, 31 NRDs) and 57 variables, using the backward variable selection method. This method enters all variables in a single step and then removes variables based on a p-value in excess of 0.15. Results determine which variables are significant in modeling the number of male high quality enlistments attained. The data is then divided into two subsets. Recruiting Areas 1 and 3 (15 NRDs) comprise one set and Recruiting Areas 5 and 8 (16 NRDs) comprise the other. Regression analyses performed on each subset and their comparison determines if the structural forms for the two subsets are consistent. Finally, the results from Recruiting Areas 1 and 3 predict the number of new male A-cell contracts for Recruiting Areas 5 and 8.

2. 2SLS Results

Results from 2SLS regression on the three sets of data are difficult to compare. Manipulation of the instrumental variables is necessary with each data set in order for the results to be even somewhat reasonable. Additionally, the level of significance for various explanatory variables is problematic. Between the three models, total advertising effect varies from a low of -0.265 to a high of 0.897. Due to the difficulties encountered during model formulation and the inconsistencies in results, it is concluded that 2SLS regression with instrumental variables is not a useful modeling tool for this set of data. All remaining analysis and results presented are obtained using OLS regression.

a) Determination of Significant Explanatory Variables

Results from the initial regression analysis for the entire data set indicate that several explanatory variables have high p-values, the (two-tailed) probability of

observing a coefficient of the observed or greater magnitude if the true coefficient is zero. In nine steps, the backward selection method eliminated the following variables: Joint journal impressions, Navy journal impressions, NRD 312, NRD 316, NRD 334, NRD 531, July, and September. Explanatory variables for all remaining analyses do not include these variables.

After elimination of the variables listed above, regression analysis is repeated on the entire data set to determine a proper model. It is necessary at this point to determine whether the linear or quadratic time trend effect provides better results. Additionally, it is necessary to determine which depreciation rate for the "stock" of advertising is appropriate.

The use of the quadratic time trend explanatory variable indicates that all advertising variable coefficients have counterintuitive signs (negative). Therefore, results that follow have time modeled as a linear function. Depreciation of the stock of advertising at a rate of ten percent results higher Adjusted R^2. The Adjusted R^2 for this model was 0.688. The standard error of the estimate (estimate of residual σ) is 14.75.

Figure 6 shows a scatterplot of male A-cell new contracts versus the standardized residuals for male A-cell new contracts. Figure 7 shows a normal probability plot for the standardized residuals. Table 2 summarizes the results of the OLS regression for the advertising variables. Appendix A contains descriptive statistics, regression coefficients for the first model in the stepwise process and the final model, residual statistics for the final model, and casewise diagnostics for the final model.

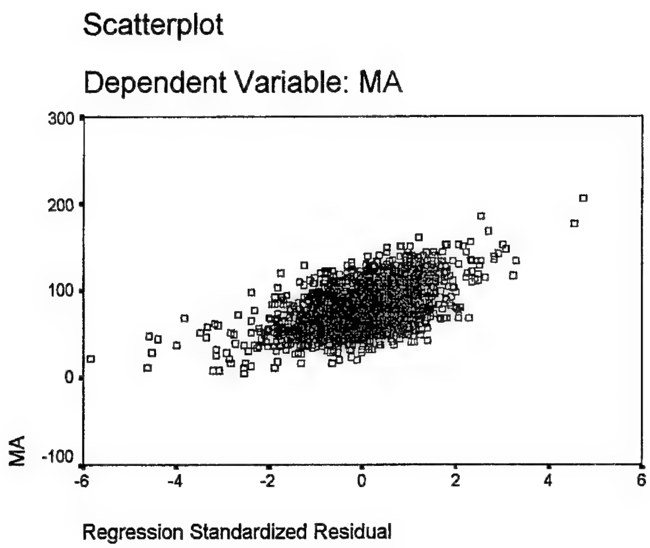


Figure 6. Scatterplot-Male A-cells vs Standandardized Residual Values.

As shown above, the variation in the residuals does not appear completely random. It is curious that the smaller male A-cell values fall below, and the larger male A-cell values fall above, the fitted equation.

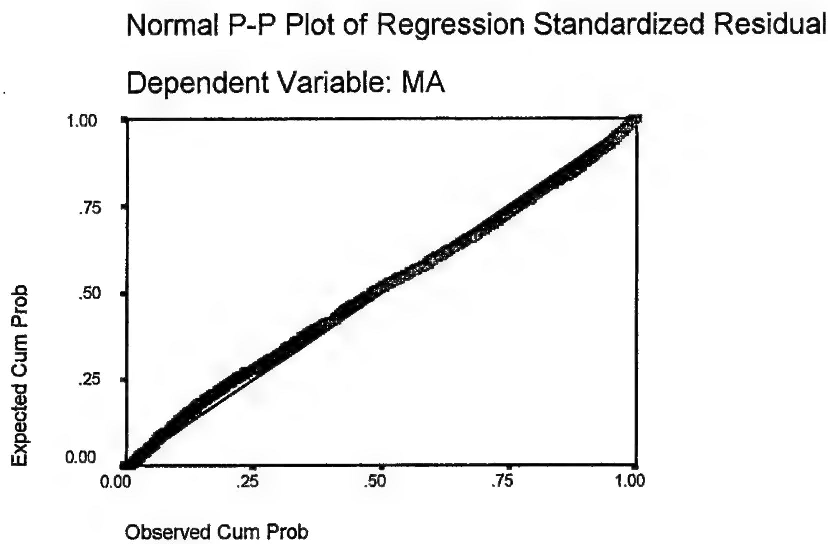


Figure 7. Normal Probability Plot for Entire Data Set.

Based on the normal probability plot, the normality assumption appears valid.

Variable	OLS		
	β	t	Sig
JMIS10	1.374E-04	3.262	0.003
JTIS10	- 5.2E-06	-3.585	0.000
NMIS10	2.374E-04	5.451	0.000
NRIS10	2.042E-06	6.867	0.000
NTIS10	1.919E-06	3.234	0.001

Table 2. Results for Advertising Variables.

Results shown in Table 2 indicate that Joint direct mail impressions, Navy direct mail impressions, Navy radio impressions, and Navy television impressions have positive statistical significance in influencing male A-cell new contracts. Joint television impression results indicate negative statistical significance.

C. TEST OF STRUCTURAL CHANGE

Three separate OLS regressions are run on the data. To test the restriction that the coefficients in the equations for the two subsets of data are the same, an *F* statistic is constructed as follows:

$$F = \frac{(RSS_{\text{entire data set}} - RSS_{\text{Area 1 \& 3}} - RSS_{\text{Area 5 \& 8}})/k}{(RSS_{\text{Area 1 \& 3}} + RSS_{\text{Area 5 \& 8}})/(\text{number of observations in entire data set} - 2k)}$$

where k is the number of coefficients estimated in a single subset of the data and RSS is the residual sum of squares.

The calculated F statistic is 2.51. This exceeds the table value of 1.46 for $\alpha = 0.05$. Therefore, the null hypothesis that the coefficients are the same for the two data subsets is rejected.

Results for the two data sets show moderate variation in the coefficient estimates in several areas. The most notable variations are in the estimates of the effects of the size of the male upper mental group, Navy direct mail impressions, and the constant.

D. PREDICTIVE VALUE OF THE MODEL

The coefficients from the OLS regression for Recruiting Areas 1 and 3 (See APPENDIX B for complete results) predicts the dependent variable for Recruiting Areas 5

and 8 (See APPENDIX C for complete results). APPENDICES B and C contain descriptive statistics, a model summary using the model determined with the backward elimination process for the entire data set, ANOVA results, coefficient results, casewise diagnostics, residual statistics, a normal probability plot of standardized residuals, and a scatterplot of standardized residuals for Recruiting Areas 1 and 3 and Recruiting Areas 5 and 8, respectively.

The summation of the absolute value of the differences between the predicted number of male A-cell contracts and actual number of male A-cell new contracts (for 959 observations) totaled 21,060.95. Each observation is off by an average of 21.96, which is slightly less than the standard deviation of 26.40 for male A-cell new contracts.

Another measure of the predictive quality of the model is a comparison of total predicted male A-cell new contracts and total actual male A-cell contracts. The model underestimates male A-cell new contracts by 1,255.98 over the 959 observations. The model for Recruiting Areas 1 and 3 underestimates each observation for Recruiting Areas 5 and 8 by an average of 1.31.

The model for Recruiting Areas 1 and 3 seems to have good predictive value for Recruiting Areas 5 and 8, despite the formal rejection of equal coefficients from the test of structural change.

E. INTERPRETATION OF RESULTS

1. Method for Comparing Results

The goodness of fit of various models is compared using the Adjusted R^2, p-values, and residuals. Since the R^2 value never decreases when another variable is added to a regression equation, Adjusted R^2 is considered a more sensitive measure. Additional variables produce an increase in Adjusted R^2 only when the absolute value of the *t* ratio associated with the variable is greater than one.

2. OLS Model Summary

Table 3 and Table 4 contain the results for the OLS Regression and the ANOVA for the entire data set. Table 4, shows a significance of the F statistic for the model as 0.000, which is an excellent result.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
9	.834	.696	.688	14.75	1.638

Table 3. Model Summary For Entire Data Set.

ANOVA

Model 9	Sum of Squares	df	Mean Square	F	Sig
Regression	900424.5	47	19157.968	88.046	.000
Residual	394056.5	1811	217.591		
Total	1294481	1858			

Table 4 ANOVA Results for the Entire Data Set.

F. CONVERSION OF RESULTS TO ELASTICITIES

Economic data is often expressed in the form of elasticities. In the case of enlistment supply, elasticity is the degree of responsiveness of enlistments to changes in the recruiting environment (e.g., unemployment, pay ratio, benefits, level of advertising). Expression of elasticity in percentage changes is common and is independent of the units used to measure the variables involved.

Since this thesis does not model in terms of natural logs, conversion of the results from the regression coefficients to elasiticities is necessary. Elasticity is percent change in y divided by percent change in x_i for each variable. Therefore,

$$(\Delta y / y) / (\Delta x_i / x_i) = (\Delta y / \Delta x_i)(x_i / y) \text{ and}$$

$$\beta = dy / dx_i \text{, therefore, evaluation at the means gives}$$

$$\text{Elasticity}_i = (\beta_i \; \bar{x}_i) / \; \bar{y}.$$

Expression in this form provides the benefit of easy interpretation. For instance, an elasticity of 0.048 means that a unit increase in the value of the variable induces an

expected increase of 0.048 in high quality enlistments. Table 5 summarizes regression coefficients expressed as elasticities.

Variable	Elasticity
JMIS10	0.048
JTIS10	-0.005
MCPR	0.688
MUMG	0.842
NCO	0.512
NMIS10	0.043
NRIS10	0.107
NTIS10	0.027
RECR	0.125
UNEMP	0.262

Table 5. Elasticities for Explanatory Variables.

Based on the results in Table 5, a unit increase in either Joint direct mail impressions or Navy direct mail impressions causes an increase in male A-cell new contracts of approximately the same size, 0.048 and 0.045, respectively. A unit increase in Navy radio impressions produces more than twice the increase than that produced by a unit increase in either Joint or Navy direct mail impressions. A unit increase in Navy television impressions causes an increase of 0.027 in male A-cell new contracts. At current

advertising levels, Navy radio impressions cause the greatest increase in male A-cell new contracts. The elasticity for Joint television impressions indicates a decrease of 0.5 percent for a unit increase in Joint television impressions. The negative sign for this variable could be due to multicollinearity in the data.

Analyses show that increases in Joint direct mail impressions, Navy direct mail impressions, Navy television impressions, and Navy radio impressions are all positive and statistically significant in influencing male A-cell new contracts. The results shown above can be used in forecasting high quality recruit response to changes in advertising levels and environmental factors.

IV. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUDING REMARKS

The recruiting environment has been in a volatile state for the past several years. Achievement of recruiting goals has been more difficult due to various factors. Propensity to enlist has declined, the target population size is no longer experiencing growth, and budgets have been severely restricted. In such a rapidly changing environment, resources must be used effectively. This thesis shows how advertising impacts recruiting performance.

Results from this thesis indicate that Navy radio impressions, Navy television impressions, Navy direct mail impressions, and Joint direct mail impressions all have positive statistical significance in influencing male high quality enlistments. These results provide justification for continued funding of these activities. Additionally, results support utilization of a linear time trend effect and an advertising "stock" depreciation rate of ten percent.

B. APPLICATION OF RESULTS

Results from this study can be incorporated into the Advertising Production Resource Optimization Model (AdPRO) [Mccloy, et al, 1992]. This model allows the user to input the desired number and quality mix of accessions/DEP stock over a specified time period. The state of the recruiting market (e.g., unemployment, relative pay) must also be specified. The model then calculates the minimum budget and the resource mix necessary to meet the recruiting goal. Alternatively, the model may also be employed to calculate the feasible accessions for a given budget.

C. RECOMMENDATIONS FOR FUTURE STUDIES

1. Extensions of the Current Study

Additional experimentation with the depreciation rate of the advertising "stock" may provide added insight for modeling. The various forms of advertising "stock" could be depreciated at different rates in the same model. For example, Navy television impressions could be depreciated at a rate of ten percent while Navy journal impressions could be depreciated at a rate of 25 percent.

2. Proposed Areas for Future Study

Collection of local advertising data in a manner similar to the method utilized for national advertising data would provide a basis for an analysis of the effectiveness of local advertising programs. Results from this type of study could be used by Area Commanders and NRD Commanders to better allocate local advertising resources. Local advertising efforts could be tailored to specifically meet the regional needs to better support the national advertising resources.

APPENDIX A: RESULTS FOR ENTIRE DATA SET

Descriptive Statistics

	Mean	Std. Deviation	N
MA	79.43	26.40	1859
JJIS10	1793907	1397804	1859
JMIS10	27579.40	13718.33	1859
JTIS10	74868.79	313868.99	1859
MCPR	.5696	4.024E-02	1859
MUMG	96353.80	28888.76	1859
NCO	155.94	34.14	1859
NJIS10	1366456	632126.14	1859
NMIS10	14313.24	10597.15	1859
NRIS10	4157522	2571390	1859
NTIS10	1108682	1191098	1859
RECR	118.04	23.73	1859
UNEMP	6.4095	1.3927	1859

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-86.583	28.194		-3.071	.002
	APR	-9.959	1.822	-.104	-5.466	.000
	AUG	3.948	1.825	.041	2.163	.031
	DEC	-4.755	1.870	-.050	-2.542	.011
	DSTORM	-13.713	2.504	-.144	-5.477	.000
	FEB	-4.467	1.680	-.047	-2.659	.008
	JJIS10	1.669E-07	.000	.009	.457	.648
	JMIS10	1.462E-04	.000	.076	3.335	.001
	JTIS10	-4.7E-06	.000	-.056	-3.132	.002
	JUL	.576	1.773	.006	.325	.745
	JUN	-7.814	1.731	-.082	-4.514	.000
	MAR	-2.695	1.759	-.028	-1.532	.126
	MAY	-17.709	1.822	-.184	-9.719	.000
	MCPR	110.825	36.583	.169	3.029	.002
	MUMG	7.029E-04	.000	.769	5.194	.000
	NCO	.254	.020	.328	12.940	.000
	NJIS10	-7.4E-07	.000	-.018	-.708	.479
	NMIS10	2.407E-04	.000	.097	5.268	.000
	NOV	-4.611	1.868	-.048	-2.468	.014
	NRD102	-47.516	11.484	-.318	-4.138	.000
	NRD103	-33.092	8.548	-.222	-3.871	.000
	NRD104	-74.763	11.311	-.501	-6.610	.000
	NRD118	-31.663	6.795	-.212	-4.660	.000
	NRD119	-33.078	7.457	-.222	-4.436	.000
	NRD120	-52.299	9.089	-.350	-5.754	.000
	NRD122	-39.632	7.319	-.265	-5.415	.000
	NRD310	-5.777	2.891	-.039	-1.999	.046
	NRD312	.381	2.943	.003	.129	.897
	NRD313	-12.712	4.064	-.085	-3.128	.002
	NRD314	-24.892	5.255	-.167	-4.736	.000
	NRD315	-4.798	3.644	-.032	-1.317	.188
	NRD316	.479	4.117	.003	.116	.907
	NRD334	-2.530	3.328	-.017	-.760	.447
	NRD348	-10.035	2.964	-.067	-3.386	.001
	NRD521	-39.091	7.746	-.262	-5.047	.000
	NRD527	-11.538	4.604	-.077	-2.506	.012
	NRD528	-40.602	8.167	-.272	-4.971	.000
	NRD529	-15.820	4.929	-.106	-3.209	.001

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	NRD531	-3.313	3.076	-.022	-1.077	.282
	NRD532	6.934	2.921	.043	2.374	.018
	NRD542	-15.655	4.970	-.111	-3.150	.002
	NRD547	-14.967	3.816	-.100	-3.922	.000
	NRD825	16.781	3.792	.112	4.426	.000
	NRD830	11.467	3.875	.077	2.959	.003
	NRD836	-55.506	8.545	-.372	-6.496	.000
	NRD837	-7.854	4.866	-.053	-1.614	.107
	NRD838	-33.522	8.632	-.225	-3.883	.000
	NRD839	3.980	4.096	.027	.972	.331
	NRD840	-13.556	5.572	-.091	-2.433	.015
	NRIS10	2.108E-06	.000	.205	6.926	.000
	NTIS10	1.878E-06	.000	.085	3.120	.002
	OCT	-4.369	1.928	-.046	-2.265	.024
	RECR	8.675E-02	.029	.078	2.965	.003
	SEP	-1.704	1.871	-.018	-.911	.363
	TTREND	-.892	.041	-.585	-21.547	.000
	UNEMP	3.090	.552	.163	5.600	.000

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
9	(Constant)	-80.739	19.444		-4.152	.000
	APR	-9.748	1.448	-.102	-6.733	.000
	AUG	4.274	1.411	.045	3.030	.002
	DEC	-4.330	1.521	-.045	-2.847	.004
	DSTORM	-13.217	2.409	-.138	-5.487	.000
	FEB	-4.276	1.432	-.045	-2.986	.003
	JMIS10	1.374E-04	.000	.071	3.262	.001
	JTIS10	-5.2E-06	.000	-.062	-3.585	.000
	JUN	-7.568	1.389	-.079	-5.450	.000
	MAR	-2.466	1.422	-.026	-1.734	.083
	MAY	-17.326	1.475	-.180	-11.749	.000
	MCPR	95.905	24.339	.146	3.940	.000
	MUMG	6.943E-04	.000	.760	7.556	.000
	NCO	.261	.019	.338	13.827	.000
	NMIS10	2.374E-04	.000	.095	5.451	.000
	NOV	-4.306	1.429	-.045	-3.013	.003
	NRD102	-47.455	7.606	-.318	-6.239	.000
	NRD103	-32.722	5.598	-.219	-5.846	.000
	NRD104	-74.826	7.679	-.501	-9.745	.000
	NRD118	-31.166	4.704	-.209	-6.626	.000
	NRD119	-32.926	4.993	-.221	-6.595	.000
	NRD120	-51.216	6.186	-.343	-8.280	.000
	NRD122	-38.758	5.253	-.260	-7.379	.000
	NRD310	-4.323	2.200	-.029	-1.965	.050
	NRD313	-11.397	3.123	-.076	-3.649	.000
	NRD314	-24.111	3.555	-.161	-6.783	.000
	NRD315	-3.999	2.410	-.027	-1.659	.097
	NRD348	-8.575	2.485	-.057	-3.450	.001
	NRD521	-38.752	5.057	-.260	-7.663	.000
	NRD527	-10.419	3.117	-.070	-3.343	.001
	NRD528	-39.172	5.515	-.262	-7.102	.000
	NRD529	-14.118	3.384	-.095	-4.171	.000
	NRD532	8.268	2.309	.051	3.580	.000
	NRD542	-14.697	3.225	-.105	-4.557	.000
	NRD547	-14.355	2.586	-.096	-5.552	.000
	NRD825	18.432	2.725	.123	6.764	.000
	NRD830	12.236	2.626	.082	4.659	.000

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
9	NRD836	-55.001	5.989	-.368	-9.184	.000
	NRD837	-6.998	3.098	-.047	-2.259	.024
	NRD838	-33.465	6.078	-.224	-5.506	.000
	NRD839	4.145	2.598	.028	1.595	.111
	NRD840	-13.311	3.737	-.089	-3.562	.000
	NRIS10	2.042E-06	.000	.199	6.867	.000
	NTIS10	1.919E-06	.000	.087	3.234	.001
	OCT	-3.961	1.461	-.042	-2.712	.007
	RECR	8.430E-02	.027	.076	3.076	.002
	TTREND	-.882	.040	-.579	-22.315	.000
	UNEMP	3.249	.507	.171	6.411	.000

a. Dependent Variable: MA

Residuals Statistics [a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	22.38	147.59	79.43	22.01	1859
Residual	-86.40	69.78	-4.13E-13	14.56	1859
Std. Predicted Value	-2.591	3.096	.000	1.000	1859
Std. Residual	-5.857	4.730	.000	.987	1859

a. Dependent Variable: MA

Casewise Diagnostics [a]

Case Number	Std. Residual	MA	Predicted Value	Residual
24	4.559	176	108.76	67.24
56	-4.524	28	94.73	-66.73
199	-3.176	61	107.85	-46.85
226	-4.612	11	79.03	-68.03
228	-3.125	32	78.09	-46.09
309	-3.346	46	95.36	-49.36
331	-3.195	8	55.13	-47.13
362	-4.593	48	115.75	-67.75
372	4.730	206	136.22	69.78
602	-3.480	51	102.33	-51.33
623	-5.857	22	108.40	-86.40
633	-3.144	25	71.38	-46.38
817	-3.080	9	54.43	-45.43
1043	-3.986	37	95.80	-58.80
1569	-3.111	60	105.88	-45.88
1639	-4.379	44	108.60	-64.60
1640	-3.816	68	124.29	-56.29
1689	-3.324	58	107.04	-49.04
1770	3.238	117	69.24	47.76
1793	3.300	134	85.32	48.68
1811	3.077	147	101.61	45.39

a. Dependent Variable: MA

APPENDIX B: RESULTS FOR RECRUITING AREAS 1 AND 3

Descriptive Statistics

	Mean	Std. Deviation	N
MA	82.91	27.99	900
JMIS10	28467.50	10477.75	900
MCPR	.5680	4.666E-02	900
MUMG	100611.86	32676.37	900
NCO	166.55	31.49	900
NMIS10	14770.26	8499.59	900
NRIS10	5245753	2929489	900
NTIS10	1240825	1317914	900
RECR	126.34	22.17	900
UNEMP	6.5529	1.1979	900

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.844[a]	.712	.701	15.31	1.762

a. Predictors: (Constant), UNEMP, NRIS10, AUG, NRD118, MAR, NRD103, NRD120, MAY, NRD310, JUN, JTIS10, DEC, NRD314, NRD122, NRD313, NOV, NRD102, FEB, NRD316, APR, NRD119, OCT, NRD312, NRD348, NMIS10, JMIS10, DSTORM, NRD315, RECR, NCO, NTIS10, NRD104, TTREND, MCPR, MUMG

b. Dependent Variable: MA

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	501785.3	35	14336.723	61.154	.000[a]
	Residual	202553.1	864	234.436		
	Total	704338.4	899			

a. Predictors: (Constant), UNEMP, NRIS10, AUG, NRD118, MAR, NRD103, NRD120, MAY, NRD310, JUN, JTIS10, DEC, NRD314, NRD122, NRD313, NOV, NRD102, FEB, NRD316, APR, NRD119, OCT, NRD312, NRD348, NMIS10, JMIS10, DSTORM, NRD315, RECR, NCO, NTIS10, NRD104, TTREND, MCPR, MUMG

b. Dependent Variable: MA

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-97.130	40.029		-2.426	.015
	APR	-12.978	2.224	-.127	-5.836	.000
	AUG	4.781	2.114	.047	2.261	.024
	DEC	-3.680	2.379	-.036	-1.547	.122
	DSTORM	-15.401	3.803	-.152	-4.050	.000
	FEB	-4.619	2.192	-.045	-2.107	.035
	JMIS10	1.443E-04	.000	.054	1.817	.070
	JTIS10	-4.15E-06	.000	-.052	-2.103	.036
	JUN	-11.919	2.096	-.117	-5.687	.000
	MAR	-5.670	2.203	-.056	-2.574	.010
	MAY	-18.986	2.248	-.185	-8.445	.000
	MCPR	186.458	52.380	.311	3.560	.000
	MUMG	3.669E-04	.000	.428	1.484	.138
	NCO	.213	.029	.239	7.381	.000
	NMIS10	5.170E-04	.000	.157	4.921	.000
	NOV	-4.030	2.191	-.040	-1.839	.066
	NRD102	-1.168	24.283	-.010	-.048	.962
	NRD103	2.631	18.473	.023	.142	.887
	NRD104	-30.048	23.806	-.268	-1.262	.207
	NRD118	-.899	14.928	-.008	-.060	.952
	NRD119	-1.612	16.213	-.014	-.099	.921
	NRD120	-21.433	19.726	-.191	-1.087	.278
	NRD122	-10.948	16.060	-.098	-.682	.496
	NRD310	-1.536	3.338	-.014	-.460	.645
	NRD312	6.264	3.393	.056	1.846	.065
	NRD313	3.244	8.725	.029	.372	.710
	NRD314	-2.533	11.726	-.023	-.216	.829
	NRD315	11.299	7.092	.101	1.593	.111
	NRD316	18.242	7.056	.163	2.585	.010
	NRD348	-3.481	5.615	-.031	-.620	.535
	NRIS10	1.914E-06	.000	.200	4.726	.000
	NTIS10	1.994E-06	.000	.094	2.307	.021
	OCT	-3.802	2.236	-.038	-1.700	.089
	RECR	4.384E-02	.045	.035	.983	.326
	TTREND	-1.252	.077	-.775	-16.347	.000
	UNEMP	2.890	.856	.124	3.374	.001

a. Dependent Variable: MA

Casewise Diagnostics[a]

Case Number	Std. Residual	MA	Predicted Value	Residual
24	4.385	176	108.86	67.14
56	-4.475	28	96.52	-68.52
226	-4.269	11	76.37	-65.37
309	-3.064	46	92.92	-46.92
331	-3.128	8	55.89	-47.89
362	-4.592	48	118.32	-70.32
372	4.534	206	136.58	69.42
602	-3.202	51	100.03	-49.03
623	-5.643	22	108.41	-86.41

a. Dependent Variable: MA

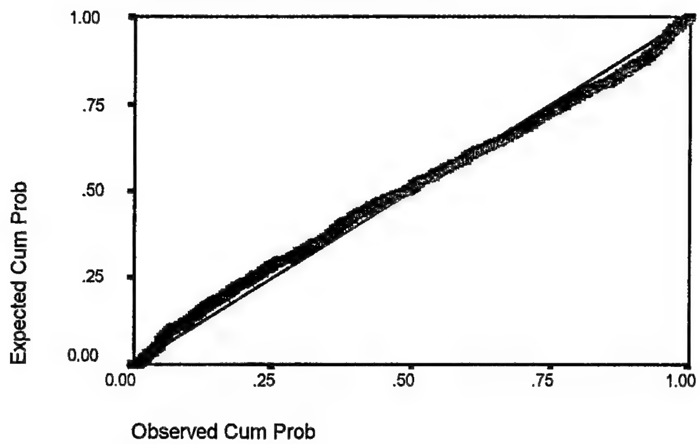
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	23.71	147.59	82.91	23.63	900
Residual	-86.41	69.42	2.21E-13	15.01	900
Std. Predicted Value	-2.506	2.737	.000	1.000	900
Std. Residual	-5.643	4.534	.000	.980	900

a. Dependent Variable: MA

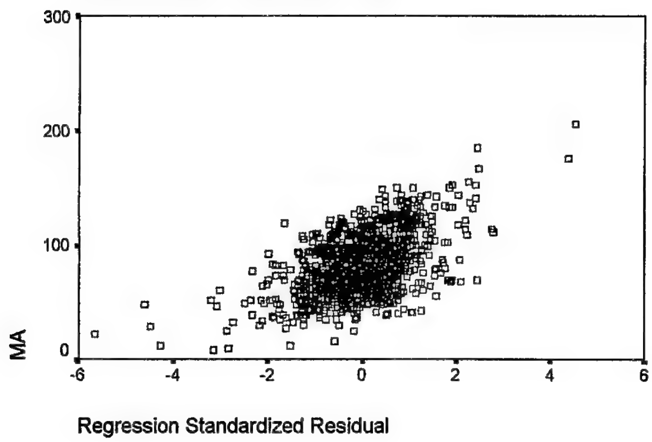
Normal P-P Plot of Regression Standardized Residual

Dependent Variable: MA



Scatterplot

Dependent Variable: MA



APPENDIX C: RESULTS FOR RECRUITING AREAS 5 AND 8

Descriptive Statistics

	Mean	Std. Deviation	N
MA	76.16	24.37	959
JMIS10	26745.95	16141.05	959
JTIS10	64746.41	275589.84	959
MCPR	.5711	3.306E-02	959
MUMG	92357.71	24157.60	959
NCO	145.98	33.53	959
NMIS10	13884.34	12232.17	959
NRIS10	3136241	1616710	959
NTIS10	984668.24	1043939	959
RECR	110.24	22.48	959
UNEMP	6.2748	1.5420	959

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.834[a]	.695	.684	13.70	1.634

a. Predictors: (Constant), UNEMP, NRD521, APR, NRD547, JUN, NRD830, DEC, NTIS10, NRD839, AUG, NRD532, NRD542, MAR, NRD837, MAY, NRD527, OCT, NRD840, FEB, NRD528, DSTORM, NRD825, NRD838, NMIS10, JTIS10, JMIS10, NCO, NRD529, NRD836, NRIS10, RECR, TTREND, MCPR, MUMG

b. Dependent Variable: MA

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	395579.4	34	11634.689	62.015	.000[a]
	Residual	173352.4	924	187.611		
	Total	568931.8	958			

a. Predictors: (Constant), UNEMP, NRD521, APR, NRD547, JUN, NRD830, DEC, NTIS10, NRD839, AUG, NRD532, NRD542, MAR, NRD837, MAY, NRD527, OCT, NRD840, FEB, NRD528, DSTORM, NRD825, NRD838, NMIS10, JTIS10, JMIS10, NCO, NRD529, NRD836, NRIS10, RECR, TTREND, MCPR, MUMG

b. Dependent Variable: MA

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-75.089	36.530		-2.056	.040
	APR	-7.942	1.835	-.090	-4.327	.000
	AUG	4.842	1.768	.055	2.739	.006
	DEC	-3.833	1.883	-.044	-2.035	.042
	DSTORM	-10.481	3.146	-.119	-3.331	.001
	FEB	-4.297	1.829	-.049	-2.349	.019
	JMIS10	1.110E-04	.000	.074	2.283	.023
	JTIS10	-5.99E-06	.000	-.068	-2.782	.006
	JUN	-3.475	1.757	-.039	-1.978	.048
	MAR	-.509	1.819	-.006	-.280	.779
	MAY	-16.822	1.879	-.191	-8.955	.000
	MCPR	101.398	50.103	.138	2.024	.043
	MUMG	4.603E-04	.000	.456	3.001	.003
	NCO	.296	.026	.408	11.588	.000
	NMIS10	1.586E-04	.000	.080	3.312	.001
	NRD521	-27.108	8.110	-.270	-3.343	.001
	NRD527	-6.556	4.008	-.065	-1.635	.102
	NRD528	-28.859	8.117	-.287	-3.555	.000
	NRD529	-9.288	3.961	-.092	-2.345	.019
	NRD532	8.693	2.382	.080	3.649	.000
	NRD542	-9.110	4.518	-.096	-2.016	.044
	NRD547	-11.208	3.639	-.111	-3.080	.002
	NRD825	13.951	4.295	.139	3.248	.001
	NRD830	11.651	4.397	.116	2.650	.008
	NRD836	-40.540	9.364	-.403	-4.330	.000
	NRD837	.280	4.689	.003	.060	.952
	NRD838	-19.069	9.713	-.190	-1.963	.050
	NRD839	7.234	4.673	.072	1.548	.122
	NRD840	-4.690	6.039	-.047	-.777	.438
	NRIS10	2.803E-06	.000	.186	5.459	.000
	NTIS10	1.776E-06	.000	.076	2.016	.044
	OCT	-2.412	1.792	-.027	-1.346	.179
	RECR	9.370E-02	.037	.086	2.517	.012
	TTREND	-.740	.049	-.525	-15.054	.000
	UNEMP	2.478	.686	.157	3.615	.000

a. Dependent Variable: MA

Casewise Diagnostics[a]

Case Number	Std. Residual	MA	Predicted Value	Residual
143	-4.199	37	94.51	-57.51
467	-3.403	22	68.62	-46.62
669	-3.324	60	105.53	-45.53
739	-4.660	44	107.83	-63.83
740	-4.269	68	126.48	-58.48
789	-3.515	58	106.14	-48.14
870	3.553	117	68.34	48.66
893	3.178	134	90.48	43.52
911	3.504	147	99.01	47.99
931	-3.032	17	58.53	-41.53

a. Dependent Variable: MA

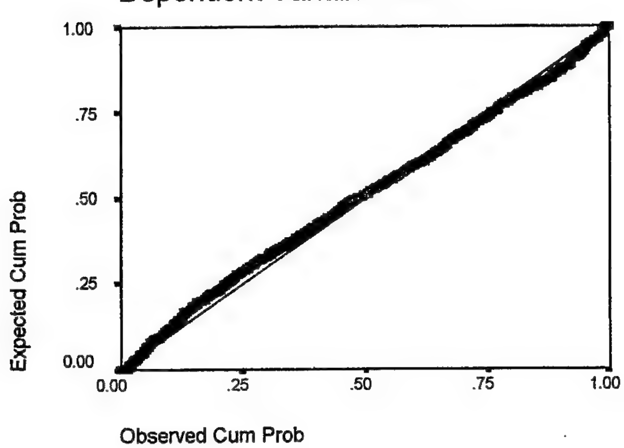
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	22.53	144.94	76.16	20.32	959
Residual	-63.83	48.66	-1.48E-14	13.45	959
Std. Predicted Value	-2.639	3.385	.000	1.000	959
Std. Residual	-4.660	3.553	.000	.982	959

a. Dependent Variable: MA

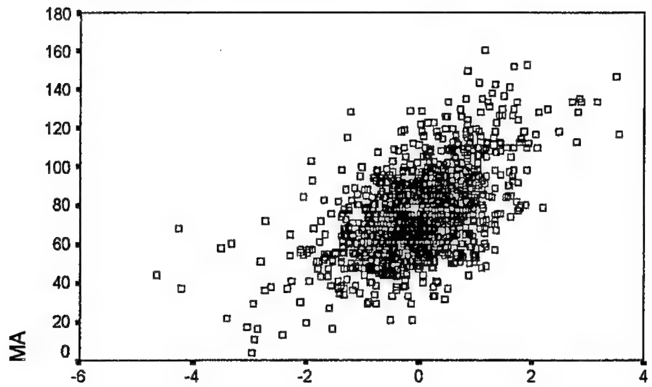
Normal P-P Plot of Regression Standardized Residua

Dependent Variable: MA



Scatterplot

Dependent Variable: MA



Regression Standardized Residual

LIST OF REFERENCES

Arima, James K., *Advertising Budgets, Advertising Effectiveness, and the Navy's Recruiting Advertising Program*, NPS54-78-009 Final Report, December 1978.

Bohn, Don, Analyst, Navy Recruiting Command, Arlington, VA, personal communications, July - September 1997.

Carroll, Vincent P., *DOD Advertising Mix Test*, Wharton Center for Applied Research, 1987.

Dertouzos, James N., *The Effects of Military Advertising: Evidence from the Advertising Mix Test*, The RAND Corporation, N-2907-FMP, March 1989.

Dertouzos, James N., and J. Michael Polich, *Effectiveness of Army Advertising*, The RAND Corporation, R-3577-FMP, January 1989.

Daula, Thomas and D. Alton Smith, "Estimating Enlistment Models for the U. S. Army," *Research in Labor Economics*, Vol. 7, 1985, pp.101-104.

Goldberg, Lawrence, "Recruiters, Advertising, and Navy Enlistments," *Naval Research Logistics Quarterly*, Vol. 29, No. 2, 1982, pp.385-398.

Greene, William H., *Econometric Analysis*, Prentice Hall, Upper Saddle River, New Jersey, 1997.

Hanssens, Dominique M. and Henry A. Levien, "An Econometric Study of Recruitment Marketing in the U. S. Navy ," *Management Science*, Vol.29, No. 10, October 1983, pp.1167-1184.

Lewin Group and SAG Corporation, *An Econometric Analysis of Navy Television Advertising Effectiveness*, unpublished paper, May 1996.

McCloy, Rodney A. et al, *Accession Quality, Job Performance, and Cost: A Cost-Performance Tradeoff Model*, CNRC Report, 1992.

Morey, Richard C. and John M. McCann, *Armed Forces Recruiting Research: Issues, Findings, and Needs*, ONR Report 200-1, 1981.

Nie, Norman H., C. Handlai Hull, Jean G. Jenkins, Karin Steinbrenner, and Dale H. Bent, *Statistical Package for The Social Sciences*, McGraw-Hill, New York, 1975.

Orvis, Bruce R., Narayan Sastry and Laurie L. McDonald, *Military Recruiting Outlook*, The Rand Corporation, 1996.

Samuelson, Paul A., *Economics: An Introductory Analysis,* McGraw-Hill, New York, 1964.

Warner, John T. , "Military Recruiting Programs During the 1980s: Their Success and Policy Issues," *Contemporary Policy Issues*, Vol. 8, October 1990, pp. 312-323.

Warner, John T. and B.J. Asch, *Defense Economics,* Prentice Hall, Upper Saddle River, New Jersey, 1995.

Wittenburg, Sven-Olaf, *An Econometric Approach to Evaluate Navy Advertising Efficiency*, Master's Thesis, Naval Postgraduate School, March 1996.

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